Prevention of Infectious Disease Transmission Associated with Public Swimming and Bathing Facilities (Swimming Pools, Spas, Whirl Pools, Hot Tubs, Interactive Fountains, and Water Parks)

Technical Guidance Tool for Local Health Departments And Environmental Health Staff

Kansas Department of Health and Environment

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Mission Statement: As the state's environmental protection and public health agency, KDHE promotes responsible choices to protect the health and environment for all Kansans.

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Introduction:

The use of recreational water is growing. In the United States, an estimated 360 million visits to recreational water venues such as pools, spas and water parks are made annually. In Kansas, swimming is the second most popular exercise activity, and the use of swimming pools and whirlpool spas contribute to overall fitness and health. The Kansas Department of Health and Environment is committed to protecting the health of all Kansans.

Public perception is often that swimming pools and spas are safe and uncontaminated and there is little awareness of the potential for chlorinated water to spread disease. However, under certain conditions, recreational water activities can contribute to disease transmission and illness if proper water quality is not maintained. The widespread use of water sports venues has increased the risk of contracting a recreational water illness (RWI) associated with swimming and bathing activities. Increased problem awareness, prompt response to fecal accidents, and proper water quality maintenance are vital to the prevention of RWIs and related adverse health effects.

RWI includes disease acquired from swallowing, inhaling, or coming into contact with contaminated water. Many of the illnesses are gastrointestinal. However ear, eye, neurologic, and dermatologic problems can also occur. Primary disease transmission prevention is best achieved by adherence to national standards providing specifications for the design and sanitary operation of recreational water facilities and for the appropriate training and certification of facility operators.

Waterborne pathogens such as *Cryptosporidium*, *Giardia*, *Shigella*, and *Escherichia coli* O157:H7 are some of the pathogens responsible for RWI. These organisms are shed during acute illness but many may be shed for days or weeks following a patient's clinical recovery. For some of these pathogens, few organisms are needed to cause illness. Preventing illnesses from water is the primary reason why pools are treated with disinfectant. Many of the waterborne disease outbreaks in recreational water facilities are due to pathogens easily killed by chlorine or other disinfectants, but these chemicals simply weren't present in quantities sufficient to protect the swimmers.

The emergence of *Cryptosporidium parvum*, a foodborne and waterborne protozoan, has highlighted the importance of disease transmission in recreational water and understanding the goals of disinfection. This organism may be difficult to eradicate from water even by standard disinfection methods. During the summer of 2003, hundreds of Northeast Kansas residents were affected with *Cryptosporidium parvum* associated with recreational water facilities. In August of 2005, more than thirty-nine people in Southwest Kansas contracted *Cryptosporidium* after they were exposed to contaminated water at recreational water facility in the area. In 2007 one hundred-twenty residents in South central and Northeast Kansas were affected by *Cryptosporidium* linked to recreational water facilities. Every year, complaints of illnesses and skin irritations are reported after bathers enjoy public spas or hot tubs.

Water supplies can be contaminated inadvertently with sewage effluent or animal waste. However, the most common source of water contamination is human fecal matter or organisms

on swimmers' bodies. Fecal accidents are common, especially in venues frequented by diapered or toddler-aged children. Nonetheless, the behavior and habits of infected swimmers of any age may contaminate recreational water facilities and transmit disease to other swimmers. Reported outbreaks of disease from recreational water facilities represent only a small percentage of the probable number of RWI. It may take two to ten days before water borne pathogens cause illness, therefore it may be difficult to connect the illness with swimming activity. Additionally, many RWI's clinically present as self-limited diarrhea that lasts only a short time and outbreaks are not often reported. Epidemiology and environmental health staff of state and local health departments may be called upon when there is a potential public health risk associated with a recreational water facilities. Such situations most commonly arise as the result of complaints regarding facility operation or reported incidents of contamination with feces, blood, or vomitus.

Purpose

Existing federal water quality standards establish quality criteria for exposure to waterborne bacteria in natural waters (i.e. public lakes, beaches or swimming areas in both fresh and marine waters designated for primary contact recreation or similar full body contact). These standards do not apply to man-made facilities.

In Kansas, there are currently no statewide regulations for the construction, operation, filtration, or disinfection of public recreational water facilities; additionally there are no certification, training, or licensing requirements for facility operators. Some cities and counties in Kansas establish and enforce local ordinances to protect recreational water against naturally occurring or man-made contaminants, but standards vary across the state.

The purpose of this document is to provide general information and guidance for local health departments and environmental health staff in their efforts to maintain safe and sanitary public recreational water facilities. These guidelines will help prevent the spread of disease associated with a variety of public swimming and bathing facilities. It also provides local jurisdictions with information they may need to prevent RWI and to provide guidance on public health responses and follow up to RWI in sporadic cases and outbreaks.

While this document could be used as a guide for developing local ordinances, it is not intended to function as a stand-alone ordinance or regulation. For those who wish to pursue a regulatory approach, a sample ordinance, daily log, inspection check list, and examples of sanitation/safety signs are available as separate documents to serve as examples for inspecting and maintaining safe and sanitary Recreational Water facilities. Other useful 'Resources and References' (page 14) provide additional details for operational standards for Recreational Water.

General Aspects and Prevention of RWI

Diarrhea and RWIs

Most RWIs are associated with fecal contamination of pool water by a person experiencing diarrhea. Diarrhea may contain millions of infectious pathogens that can be easily disseminated throughout water in a relatively short amount of time. In addition, microscopic amounts of contaminated fecal matter on individuals' bodies may rinse off as they swim through the water. Other swimmers who swallow the contaminated water may then become infected and develop diarrheal illnesses.

Pathogens Spread through Recreational Water

RWI can be caused by bacteria, viruses, parasites, and chemicals. Common bacterial infections associated with recreational water venues include *Shigella,* Shiga toxin producing *E. coli Pseudomonas aeruginosa,* and *Legionella pneumophila.* Norovirus and Hepatitis A are viruses that can be transmitted via water and *Cryptosporidium* and *Giardia* are parasites. All RWI are spread through bodily contact, ingestion or inhalation of contaminated water. *Cryptosporidium parvum* has received much media attention in the last few years because of several large outbreaks associated with swimming pools, water parks, and interactive fountains.

The Role of Chlorine in the Prevention of RWIs

Available free chlorine at 2.0 parts per million (ppm) in water with a pH 7.5 kills most bacteria, like *E. coli O157:H7*, within one minute. *Hepatitis A* and *Giardia* are moderately chlorine-resistant. *Cryptosporidium* is highly chlorine-resistant and can live in recreational water for days (Table 1). Because normal chlorine levels may not be effective in killing chlorine-resistant pathogens, prompt response to fecal accidents is essential. Recommended disinfectant levels provided here are for chlorine and provided with the assumption that all other chemical parameters are at appropriate levels. Methodology for increasing the concentration (C) of available free chlorine in ppm will vary by venue. Pool operators must consult their maintenance/reference manuals for the proper procedure to raise chlorine levels and monitor the pH at their venue. When responding to a fecal accident, sufficient disinfectant concentration and adequate time for disinfection has proven to be the best course of action.

Table 1. Disinfection Times for Fecal Contaminants in Chlorinated Water*

E. coli O157:H7 bacteria	< < 1 minute
Hepatitis A virus	Approximately 16 minutes
Giardia parasite	Approximately 45 minutes
Cryptosporidium parasite	Approximately 15,300 minutes (10.6 days)

* 1 mg / L (1 ppm) chlorine at pH 7.5 and 25 C
http://www.cdc.gov/healthyswimming/chlorine_timetable.htm

Responding to Fecal Accidents in Recreational Waters:

All personnel maintaining or operating public water venues should be trained to perform proper functions that contribute to protecting the public health. Training programs are available to assist with this preventative strategy. One example of a training program is the Certified Pool/Spa Operator training offered by the National Swimming Pool Foundation. Personnel should be required to keep up-to-date with new technologies and developments in pool care.

The primary objective of a response to a fecal accident is to discontinue the use of the recreational water venue until the quality of the water returns to a level that minimizes risk of disease transmission. Diarrheal accidents in recreational waters pose a higher risk for the transmission of infectious organisms than do formed stool accidents. Numerous infectious pathogens may be present in liquid stool. In contrast, formed stool may serve as a container for pathogens, preventing their release into the water. As a result, the response to formed stool fecal accidents and diarrhea fecal accidents differs significantly.

In all cases, **when a fecal accident occurs in small facilities**, such as hot tubs, spas, and whirlpools, everyone should be ordered to leave the venue, the facility should be completely drained, sanitized and then refilled with clean water prior to further use.

Fecal accident response in larger venues requires a different response and adherence to recommended concentration of chlorine disinfectant (C = concentration) for specified period of time (T = Time). This establishes a CT value or contact time (CT = C x T).

It is important to remember that laboratory conditions for disinfection of microorganisms such as *Cryptosporidium* do not occur in recreational water environments where additional organic material (such as urine, feces, hair, sweat, skin cells, and lotion) is present, pH is uncontrolled, and calcium concentration can be elevated. *Cryptosporidium* oocysts attach readily to biologic particles that provide a protective surrounding and retards inactivation of an already chlorine-resistant organism. Cryptosporidium oocysts require a CT value of at least 15,300 to be effectively inactivated.

In response to **FORMED STOOL** fecal accidents, the following steps should be taken:

1. Direct everyone to leave the venue or pool, shut down all pools that share the same filtration system, and do not allow anyone to re-enter until all decontamination procedures have been completed.
2. Remove as much fecal material as possible using a net or scoop and dispose of the material in a sanitary manner. Clean and disinfect the net or scoop after use. NOTE: Vacuuming of stool is not recommended.

3. Raise the available free chlorine to 2.0 ppm (if less than 2.0 ppm) and ensure that the water pH is between 7.2 – 7.5. This process should take approximately 30 minutes but may vary based upon size of the venue. The pool operator should consult maintenance/reference manuals for the proper procedure to raise the chlorine levels and monitor the pH.
4. Verify the proper CT value and calculate the required disinfecting time. Concentrations and closure times may vary, but the CT inactivation value must remain constant (Table 2).
5. Ensure that the filtration system is operating during the disinfection process. **NOTE**: Local regulatory authorities may require higher chlorine levels in the presence of chlorine stabilizers such as chlorinated isocyanurates.
6. Establish and maintain a fecal accident log. Document each formed stool fecal accident by recording the date and time of the event and note the chlorine levels at the time of the accident. Before reopening, record the water pH, the procedures followed in response to the fecal accident, and the contact time (CT value).

In response to **DIARRHEAL** accidents, the following steps should be taken:

1. Direct everyone to leave the venue or pool, shut down all pools that share the same filtration system, and do not allow anyone to re-enter until all decontamination procedures have been completed.
2. Remove as much fecal material as possible using a net or scoop and dispose of the material in a sanitary manner. Clean and disinfect the net or scoop after use. NOTE: Vacuuming of stool is not recommended.
3. **Raise the available free chlorine concentration to 20 ppm and maintain water pH at 7.2 – 7.5.** This concentration should be maintained for at least 12.75 hours to ensure inactivation of *Cryptosporidium* (20 mg chlorine/L for 12.75 hours will achieve a CT value of approximately 15,300).
4. Verify the proper CT value and calculate the required disinfecting time. Concentrations and closure times may vary but the CT inactivation value must remain constant. A higher or lower free available chlorine level/inactivation time can be used as long as a CT inactivation value equaling 15,300 is maintained for *Cryptosporidium* inactivation (Table 3).
5. Ensure that the filtration system is operating and maintaining the proper free available chlorine level during the disinfection process. If a recirculation system is used it MUST be decontaminated prior to re-opening of the venue.
6. Backwash the filter thoroughly after reaching the CT value. Ensure that the effluent is discharged directly to waste in accordance to state and local regulations. Do not return the backwash through the filter. Replace the filter media where appropriate.
7. After the required CT value has been achieved return chlorine levels to the normal operating range (1.0 ppm to 3.0 ppm in most cases).
8. Establish and maintain a fecal accident log. Document each diarrhea accident by recording the date and time of the event and note the chlorine levels at the time of the accident. Before reopening, record the pH, the procedures followed in response to the fecal accident, and the contact time (CT value).

Table 2. *Giardia* Inactivation for Formed Fecal Accident

Chlorine Levels (ppm)	Disinfection Time*
1.0	45 minutes
2.0	25 minutes
3.0	19 minutes

* These closure times are based on a 99.9% inactivation of Giardia cysts by chlorine, pH 7.5, 77ºF. The closure times were derived from the Environmental Protection Agency (EPA) Disinfection Profiling and Guidance Manual. These closure times do not take into account "dead spots" and other areas of poor pool water mixing.

Table 3. *Cryptosporidium* Inactivation for Diarrheal Accident

Chlorine Levels (ppm)	Disinfection Time*†
1.0	15,300 minutes (255 hours)
10	1,530 minutes (25.5 hours)
20	765 minutes (12.75 hours)

* Shields, JM; Arrowwood, MJ; Hill, VR and Beach, MJ. (2007) Inactivation of Cryptosporidium parvum under chlorinated recreational water conditions. Journal of Water and Health. In Press.
† At pH 7.5, 77˚ F (25˚C).

Responding to Vomit Exposures from Recreational Water

Vomiting often occurs as a result of swallowing too much water and is most likely not infectious. However, the following steps should be taken to prevent the spread of Norovirus (previously known as Norwalk virus).

In response to **VOMIT** accidents in recreational water:

- Follow the protocol for responding to a formed fecal accident. The disinfection time and chlorine levels needed to kill norovirus and *Giardia* are similar (Table 2). The recommendations should be adequate for disinfecting a potentially infectious vomit accident.

Responding to Blood Exposures from Recreational Water

Bloodborne pathogens, like *Hepatitis B* virus or *HIV*, are spread when infected blood or certain body fluids enter the body and bloodstream. This most often occurs through the sharing of hypodermic syringes (needles) or through sexual contact. No evidence indicates that bloodborne pathogens are transmitted by recreational water exposure. Properly chlorinated water kills these viruses; therefore, no public health action is recommended for in water blood spills.

Cleaning Up Body Fluid Spills on Pool Surfaces

Body fluid spills that occur on pool surfaces should be cleaned and the surfaces disinfected immediately. A solution of bleach and water is adequate. Other approved commercial disinfectants can be found at http://www.epa.gov/oppad001/chemregindex.htm and http://www.fda.gov/cdrh/ode/germlab.html. Follow the manufacturer's instructions to ensure effectiveness.

The following steps should be followed for proper clean-up using bleach solutions:

1. Prepare a bleach solution by combining 1 part household bleach and 9 parts cool water. The solution should be prepared before each clean up because bleach diluted in water loses its strength quickly.
2. Block off the area of the spill from patrons until clean up and disinfection is complete.
3. Use disposable latex gloves to prevent contamination of hands.
4. Wipe up the spill using an absorbent material (e.g. paper towels) and dispose of soiled materials in plastic garbage bag.
5. Carefully pour bleach solution onto contaminated surface.
6. Leave bleach solution for 20 minutes.
7. Wipe up the remaining bleach solution.
8. Disinfect all non-disposable cleaning materials (e.g. mops and scrub brushes) in the bleach solution and allow to air dry.
9. Remove gloves and place in plastic garbage bag with the soiled materials.
10. Double-bag, securely tie, and discard the plastic garbage bag.
11. Thoroughly wash hands with warm soap and water.

Measures to Minimize the Risk of RWIs

The following guidelines can be used to reduce the transmission of waterborne disease in public water venues.

Operators:

1. Be properly trained and keep up to date with new technologies and developments in pool care.
2. The circulation and filtration system should be properly maintained to provide maximum filtration at all times. Backwash water and filtering media should be properly disposed of so venue water is not cross contaminated.
3. Venue water should always be kept clear and in chemical balance with pH between 7.2 and 7.8, alkalinity between 80 and 150 ppm, and calcium hardness between 200 and 400 ppm.
4. Pool managers should follow the 12 steps for RWI [1] Prevention:
    1. Lead your staff.
    2. Develop partnerships to safeguard public health.
    3. Educate pool staff.

4. Educate swimmers and parents.
5. Maintain water quality and equipment.
6. Evaluate aquatic facility design.
7. Institute disinfection guidelines.
8. Evaluate hygiene facilities.
9. Develop a bathroom break policy.
10. Create a special policy for large groups of young children.
11. Post and distribute health information.
12. Develop an outbreak/emergency response plan

Patrons should be encouraged to practice CDC **LAAPS**[1]:

- **L**OOK at the venue and make sure that the water is clear, the sides are smooth, there is no distinct odor, and that pool equipment appears to be working properly.
- **A**SK questions of the staff, including how often chlorine and pH levels are checked.
- **A**CT by being proactive and educating themselves and others about RWIs and how to prevent transmission.
- **P**RACTICE healthy swimming behaviors, specifically not swimming for at least 2 weeks after having diarrhea.
- **S**AFETY is always important.

Patrons can also be encouraged to practice the six **PLEAs**[1] for healthy swimming:

PLEASE don't swim when you have diarrhea. This is especially important for children in diapers.

PLEASE don't swallow the pool water.

PLEASE practice good hygiene.

PLEASE take your children on bathroom breaks often. Use "leak proof" children's swimsuits or swim diapers.

PLEASE change diapers in a bathroom and not at poolside.

PLEASE wash your child thoroughly (especially the rear end) with soap and water before swimming.

Safety and Injury Prevention:

KDHE seeks to protect the health and environment of all Kansans by promoting responsible choices. Responsible choice begins with proper education so that informed decisions can be made. Unfortunately, drowning and other water accidents are far too common in Kansas. Information from the Center for Health and Environmental Statistics at KDHE show that between 2002 and 2006, 138 Kansans died from drowning. Statistics show that the rate of drowning was approximately 3 times higher among males than among females, and the highest rate occurred among Kansas males 15-24 years of age. The lowest rates of drowning for that period occurred among female Kansans.

Venue Safety

Swimming pools, spas and water park facilities exist in all sizes, and vary greatly as to the activities and programs they provide. The key to protecting the public is to establish safety practices that create multiple layers of protection. In addition to RWI concerns, accident prevention, lifesaving and emergency issues must be addressed. Safety and lifesaving equipment requirements will vary based upon the complexity of the venue and local regulatory requirements. The following recommendations are not intended to be all-inclusive, but to suggest minimum levels of safety protection.

- Barriers that prevent unauthorized access should enclose the facility. Fences and walls should be of sufficient height to prevent accidental or unauthorized entry and should be installed completely around the venue. Fence gates should be self-closing and self-latching. Entry latches should be out of reach for small children.
- Supervision of patrons should occur whenever the venue is operational. Parents and guardians should closely watch their children at all times.
- Safety and rescue equipment should be readily available poolside including a rescue pole, an approved ring buoy attached to a throwing rope and an OSHA approved First Aid kit.
- Health and safety reminder signs should be displayed prominently at poolside.
- Post emergency numbers at poolside and provide easy access to a telephone.
- Equip venue with “anti-vortex” drain covers or multiple main drains to prevent swimmer entanglement, entrapment or evisceration.
- Red Cross certified staff trained in lifesaving and cardiopulmonary resuscitation (CPR) should be on duty when venue is operational.
- Pool equipment should be periodically check and kept in good repair.
- Use a power safety cover -- a motor-powered barrier that can be placed over the water area -- when the venue is not in use.
- Pool alarms should be used as an added precaution. Underwater pool alarms generally perform better and can be used in conjunction with pool covers.
- Manufacturer safety directions should be followed for the safe operation of hot tubs/spas.

Glossary:

Bacteria - a one-celled organism some of which can cause illness

CT- contact time, adherence to recommended available chlorine concentrations (C = concentration) for specified time (T = Time) period, (C x T = CT).

Cryptosporidiosis - A diarrheal disease caused by a parasite *Cryptosporidium parvum.* The parasite can survive outside the body for a long time and resist chlorine disinfection. One mouthful of contaminated water can cause infection.

Dermatologic - affecting the skin (includes itchy and non-itchy rashes, open wounds)

E coli 157:H7 - A strain of bacteria that causes severe diarrhea with bleeding and abdominal cramps. Primarily spread through uncooked meat, it can be contracted by swimming in contaminated water.

Gastrointestinal -affecting the stomach and intestines (includes vomiting and diarrhea)

Giardiasis - A diarrheal illness caused by a parasite that lives in the intestines of people and animals. One of the most common causes of waterborne disease in the United States; it is contracted by mouth contact with feces-contaminated water.

Hepatitis A - Caused by a virus, this disease may be spread by contact with water contaminated with human feces or by people who did not wash their hands properly. Symptoms include fever, loss of appetite and nausea, and jaundice (yellowing of the whites of the eyes or mucous membranes) although children younger than 3 may not have symptoms but can still spread the virus.

Legionellosis - a bacterial disease that causes body aches, high fever, cough and diarrhea. Disease has been spread from contaminated water in showers, spas, and fountains. The infection is not contagious from one person to another.

Leptospirosis - A bacterial disease with symptoms including high fever, severe headache, chills and vomiting. Untreated, it can cause kidney or liver damage, meningitis, and, in rare cases, death. Caused by exposure to water contaminated with the urine of infected animals.

Neurologic - affecting the brain, spinal cord and nerves

Parasite - an organism that lives in, with, or on another organism

Pathogen - a living organism that can cause disease

Recreational Water Facility - public swimming and bathing facility: would include constructed facilities open to the public such as swimming pools, water parks, water slides, interactive fountains, spas, and whirlpools.

Pseudomonas folliculitis – an infection of the skin or hair follicles from the bacterium *Pseudomonas aeruginosa*. The bacteria grow well in warm water. It appears as itchy bumps on the skin or as small pus-filled pimples. Sometimes there is also a sore throat or fever, headache and vomiting.

RWI—recreational water illness

Shigellosis - A bacterial disease that causes diarrhea, fever and stomach cramps and is spread by contact with fecal material.

Swimmer's itch - A skin rash caused by an allergic reaction to parasites found in birds and mammals that is spread by snails. The parasites are found in salt water and fresh water. Burning and itching symptoms may get worse with more exposure.

Viral gastroenteritis - Watery diarrhea and vomiting caused by a number of viruses, such as Norwalk virus. May be spread by swallowing water contaminated by infected individuals.

Virus-- submicroscopic infective agents that contain a core of genetic material, that grows and multiplies only in living cells, and that can cause illness

Resources, References, and Documents

1. CDC Healthy Swimming
   http://www.cdc.gov/healthyswimming/

2. KDHE Bureau of Environmental Health Services (758-296-0189):
   Available to address technical aspects of RWI response to contamination incidents, and general questions about sanitation.

3. KDHE Epidemiology Services (877-427-7317):
   Available to address medical questions related to contamination incidents and general questions about sanitation.

4. National Swimming Pool Foundation
   10803 Gulfdale, Suite 300
   San Antonio, TX 78216
   210-525-1227
   www.nspf.org

5. YMCA of the USA
   Aquatics Program
   1-800-USA-YMCA

6. *Certified Pool-Spa Operator Handbook.* National Swimming Pool Foundation (2nd printing) 2005.

7. *Swimming Pools: Safety and Disease Control through Proper Design and Operation*. US Department of Health and Human Services, Public Health Service, CDC, 1983. HHS Publication No. (CDC) 83-8319.

8. *Suggested Health and Safety Guidelines for Public Spas and Hot Tubs*. US Department of Health and Human Services, Public Health Service, CDC, 1985. HHS Publication No. (CDC) 99-960.

9. *YMCA Pool Operations Manual*, YMCA of the USA (3rd Edition), 2006.

10. Kebabjian RS. Disinfection of Public Pools and Management of Fecal Accidents, *Journal of Environmental Health*. July/August, 1995, 58(1), 8-12.

11. Control of Communicable Diseases Manual. 18th edition, David L. Heymann , MD, editor.American Public Health Association 2004.

12. http://www.cdc.gov/ncidod/eid/vol5no4/carpenter.htm

13. (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5020a7.htm)